

Rocky Flats Plant

00000 5135

JANUARY  
1993

ER-4180110-219

# Monthly Environmental Monitoring Report

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ADMIN RECORD

A-SW-000797

REVIEWED FOR CLASSIFICATION/UCNI
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recalculations. The newly reported data are consistent with measurements that have been made in the past.

**Uranium Airborne Effluent Concentrations -**

The uranium airborne effluent concentration for December ( $0.0761 \pm 0.0103$   $\mu\text{Ci}$  uranium-233, -234) appears slightly higher than what is typically measured for that isotope. The measured maximum for that month ( $0.0039 \pm 0.0006$   $\text{pCi}/\text{m}^3$ ) is not unusual. This suggests the December uranium-233, -234 value is not unusual.

Uranium airborne effluent concentrations for October and November were reported in the November 1992 *Monthly Environmental Monitoring Report* as slightly higher than what is typically measured. Further inquiry into those locations and related operations does not indicate any uranium-associated activities. The samples from those locations are being re-run; results will be reported as soon as they become available.

**Total Long-lived Alpha and Beta Activity**

**Screening -** Total long-lived alpha and beta activity screening, performed on air effluent sample filters prior to radiochemical processing and analysis, has not been affected by the difficulties with the Radiological Health Laboratories, and is continuing on schedule. Results of this screening for January are within normally expected ranges. RFP had no surface water discharge during the month of January; no screening results were reported.

# **Rocky Flats Plant Environmental Monitoring Report**

## **January Highlights**

Summarized below are highlights from the major data categories presented. Remaining data presented in this report are within the ranges historically measured for their respective parameters and locations.

**RFP Laboratory Status** - In August 1992, the General Laboratory at Rocky Flats Plant (RFP) was shut down because of concerns with the secondary containment for the laboratory's aqueous process waste system. Samples for nonradioactive parameters taken under the RFP Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) permit and normally analyzed in the General Laboratory are being sent to offsite contract laboratories for analyses. Use of offsite laboratories for analyzing these samples will continue until the General Laboratory resumes full operation.

The Radiological Health Laboratories continue limited operations for radionuclide analyses. Work to upgrade secondary containment in the building is still proceeding. The date by which normal laboratory operations may resume remains uncertain. Continued delays in reporting analytical results for environmental monitoring samples are expected.

Overtime work in the Radiological Health Laboratories has been requested, approved, and is being done over weekends to assist in eliminating sample backlogs. The laboratory has estimated a backlog completion date of mid-March. This backlog work is showing positive results; Airborne effluent sample analyses are now current. Errata for ambient air and water will be presented upon completion of individual errata tables.

**Airborne Effluent Calculations** - The September 1992 *Monthly Environmental Monitoring Report* described new methods of emission measurement made at RFP as directed by new EPA regulations. Consequently, airborne effluent data for 1992 have been recalculated based on changes to the exhaust air flow calculations. Tables 1, 2, and 3 of this report reflect

# 1. Introduction

The Rocky Flats Plant (RFP) has been part of a nationwide Department of Energy (DOE) complex for the research, development, and production of nuclear weapons. The plant was responsible for fabricating nuclear weapons components from plutonium, uranium, beryllium, and stainless steel. The primary production activities included metal fabrication and assembly, chemical recovery and purification of process-produced transuranic radionuclides, and related quality control functions.

This mission changed with the announcement in early 1992 that certain planned weapons systems had been canceled. RFP no longer produces weapons components, and is now in a transition phase into decontamination and disposition (D&D). Primary objectives of this new mission include achieving and maintaining compliance with environmental regulatory requirements, as well as effecting proper D&D steps that are under development.

Because radioactive and chemically hazardous materials may be used or handled at RFP during transition, the plant maintains an extensive environmental protection program. Included in that program is regular monitoring for radioactive and hazardous constituents at onsite, plant boundary, and offsite locations.

This Monthly Environmental Monitoring Report summarizes the effluent and environmental monitoring programs at the RFP for January 1993. Data presented herein reflect the best information available to the RFP at this time. If subsequent analyses indicate that any data presented herein are inaccurate or misleading, revisions will be issued promptly.

Summarized in the Executive Summary are highlights from the major data categories presented. Remaining data presented in this report are within the ranges historically measured for their respective parameters and locations.

Radiation standards for protection of the public are discussed in Appendix A of this report. The primary standards are based on calculations of radiation dose. These calculations are performed annually using monitoring data presented in the Monthly Environmental Monitoring Report. Radiation doses to the public from RFP operations are typically well below any regulatory limit and far less than are received from naturally occurring radiation sources in the Denver metropolitan area.

Appendix B lists the Volatile Organic Compounds (VOCs)

for which monitoring is required under the National Pollutant Discharge Elimination System/Federal Facilities Compliance Agreement (NPDES/FFCA). Appendix C describes Colorado Water Quality Control Commission standards for the Walnut Creek and Woman Creek drainages downstream of RFP.

Error terms in the form of "a+b" are included with some of the data. For a single sample, "a" is the analytical-blank corrected value; for multiple samples it represents the arithmetic mean, the volume-weighted mean, or the annual total, as indicated in the table. The error term "b" accounts for the propagated statistical counting uncertainty of the sample(s) and the associated analytical blanks at the 95 percent confidence level. These error terms represent a minimum estimate of error for the data.

Plutonium, uranium, americium, tritium, and beryllium measured concentrations are given in this report. Most of the measured concentrations are at or very near background levels, and often there is little or no amount of these materials in the media analyzed. When this occurs, the results of the laboratory analyses can be expected to show a statistical distribution of positive and negative numbers near zero and numbers that are less than the calculated minimum detectable concentration for the analyses. The laboratory analytical blanks, used to correct for background contributions to the measurements, show a similar statistical distribution around their average values. Negative sample values result when the measured value for a laboratory analytical blank is subtracted from a sample analytical result smaller than the analytical blank value. Results that are less than calculated minimum detectable levels indicate that the results are below the level of statistical confidence in the actual numerical values. All reported results, including negative values and values that are less than minimum detectable levels, are included in any arithmetic calculations on the data set. Reporting all values allows all of the data to be evaluated using appropriate statistical treatment. This assists in identifying any bias in the analyses, allows better evaluation of distributions and trends in environmental data, and helps in estimating the true sensitivity of the measurement process.

The reader should use caution in interpreting individual values that are negative or less than minimum detectable levels. A negative value has no physical significance. Values less than minimum detectable levels lack statistical confidence as to what the actual number is, although it is known with high confidence that it is below the specified detection level. Such values should not be interpreted as

being the actual amount of material in the sample, but should be seen as reflecting a range (from zero to the minimum detectable level) in which the actual amount would likely lie. These values are significant, however, when taken together with other analytical results that indicate that the distribution is near zero.

The data in this report are provided as a matter of courtesy and should not be construed as an application for a permit or license, or in support of such an application. Approval of the DOE should be obtained before publication of any data contained in this report.

Abbreviations used within this report are as defined.

## Abbreviations

C Average	Average concentration
C Maximum	Maximum concentration
C Minimum	Minimum concentration
m <sup>3</sup>	Cubic meter
m/s	Meters per second
mCi	Millicurie
mg/l	Milligrams per liter
mrem	Millirem
pCi/l	Picocuries per liter
pCi/m <sup>3</sup>	Picocuries per cubic meter
pH	Hydrogen ion concentration
SU	Standard Unit
μg/m <sup>3</sup>	Micrograms per cubic meter
#/100 ml	Number per 100 milliliter
μCi	Microcurie
μg/l	Micrograms per liter



## **2. Air**

### **2.1 Airborne Effluent**

RFP continuously monitors radionuclide air emissions at 53 locations in 17 buildings. The requirements outlined in the General Environmental Protection Programs (DOE Order 5400.1) and the National Emission Standards for Emissions of Radionuclides Other Than Radon From DOE Facilities (40 CFR 61, Subpart H), mandate the continuous monitoring of air emissions at all release points with the potential of discharging radionuclides into the air in quantities that could result in an effective dose equivalent (EDE) greater than 0.1 millirem per year.

The radiological particulate monitoring and sampling program uses a three-tier approach comprising Selective Alpha Air Monitors (SAAMs), total long-lived alpha screening of routine air duct emission sample filters, and radiochemical analysis of isotopes collected from air duct emission samples. This approach balances both sensitivity and timeliness of desired results. Figure 1 shows a typical radiological emission sampler configuration within an exhaust duct at the RFP.

For immediate detection of abnormal conditions, RFP building ventilation systems that service areas containing plutonium are equipped with SAAMs. SAAMs are sensitive to specific alpha particle energies and are set to detect plutonium-239 and -240. These detectors are subjected to daily operational checks, monthly performance testing and calibration for airflow, and an annual radioactive source calibration to maintain sensitivity and reliability. Monitors alarm automatically if out-of-tolerance conditions are experienced.

At regular intervals, particulate material samples from a continuous sampling system are removed from each exhaust system and radiometrically analyzed for long-lived alpha and beta emitters. The concentration of long-lived alpha and beta emitters is indicative of effluent quality and overall performance of the High Efficiency Particulate Air (HEPA) filtration system. If the total long-lived alpha concentration for an effluent sample exceeds the RFP action value of  $0.020 \times 10^{-12}$  microcuries per milliliter, a follow-up investigation is conducted to determine the cause and to evaluate the need for corrective action. The action value is equal to the most restrictive offsite Derived Concentration Guide (DCG) for plutonium activity in air.

At the end of each month, individual samples from each exhaust system are composited by location. An aliquot of each dissolved composite sample is analyzed for beryllium particulate materials. The remainder of the dissolved sample is subjected to radiochemical separation and alpha spectral analysis that quantifies specific alpha-emitting radionuclides. Analyses for uranium isotopes are conducted for each composite sample.

Forty-one of the ventilation exhaust systems are located in buildings where plutonium processing is conducted. Particulate material samples from these exhaust systems are analyzed for specific isotopes of plutonium and americium. Typically, americium contributes only a small fraction of the total alpha activity release from RFP.

Processes ventilated from several exhaust systems potentially exhibit trace quantities of tritium contamination. Impingers-type samplers are used to collect samples three times each week from the monitored locations. Tritium concentrations in the sample are measured using a liquid scintillation photospectrometer.

The calibration methodology for the beryllium analyses was changed beginning with the September 1990 samples to improve quality assurance. The previous procedure used the single-point, "simple method of additions," one of the methods recommended by the manufacturer of the graphite furnace atomic absorption analytical equipment. The current method is based on EPA Contract Laboratory Program protocol. It uses multi-point calibration curves, periodic validation of the curve with EPA validation standards, and periodic blank and sample checks to assure absence of equipment contamination and matrix effects during the analysis.

Tables 1 through 3 show monitoring results for radioactive and nonradioactive airborne effluents continuously sampled from plant buildings.

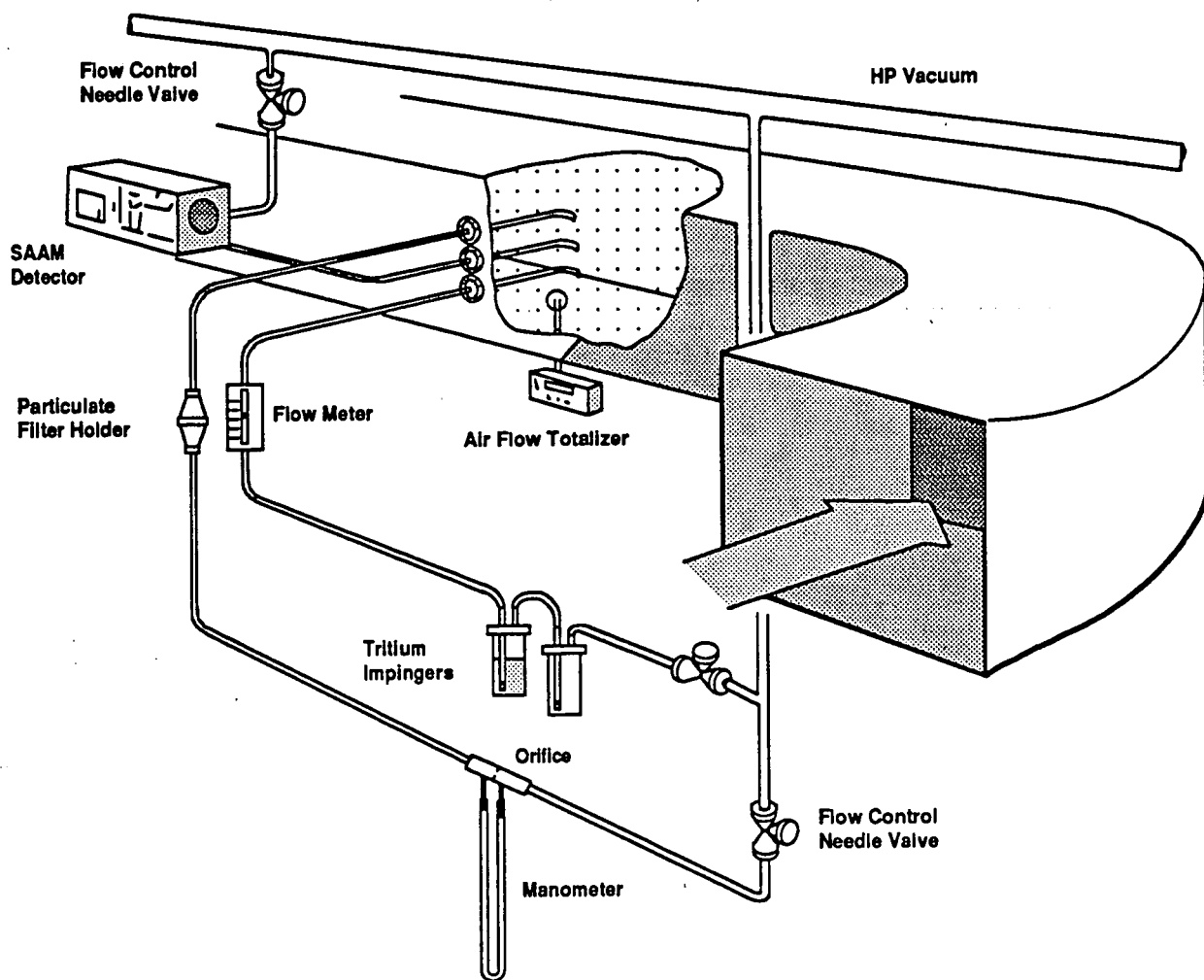


Figure 1: Radiological Effluent Air Sampling System

**Table 1****Plutonium and Americium Airborne Effluent Data**

<b>Month</b>	<b>Plutonium-239, -240</b> <b>(12/17/92 - 1/15/93)</b>		<b>Americium-241</b> <b>(12/17/92 - 1/15/93)</b>	
	<b>Release (<math>\mu\text{Ci}</math>)</b>	<b>C Maximum (<math>\text{pCi}/\text{m}^3</math>)</b>	<b>Release (<math>\mu\text{Ci}</math>)</b>	<b>C Maximum (<math>\text{pCi}/\text{m}^3</math>)</b>
<b>1992</b>				
January <sup>a</sup>	0.0320 $\pm$ 0.0045	0.0002 $\pm$ 0.0001	0.0078 $\pm$ 0.0033	0.0003 $\pm$ 0.0001
February <sup>a</sup>	0.0225 $\pm$ 0.0037	0.0001 $\pm$ 0.0000	0.0088 $\pm$ 0.0030	0.0003 $\pm$ 0.0001
March	0.0330 $\pm$ 0.0051	0.0002 $\pm$ 0.0001	0.0143 $\pm$ 0.0029	0.0012 $\pm$ 0.0002
April <sup>a</sup>	0.0179 $\pm$ 0.0031	0.0001 $\pm$ 0.0000	0.0070 $\pm$ 0.0026	0.0001 $\pm$ 0.0000
May	0.0249 $\pm$ 0.0039	0.0002 $\pm$ 0.0001	0.0198 $\pm$ 0.0037	0.0001 $\pm$ 0.0000
June	0.0839 $\pm$ 0.0109	0.0014 $\pm$ 0.0002	0.1069 $\pm$ 0.0141	0.0010 $\pm$ 0.0002
July <sup>a</sup>	0.0135 $\pm$ 0.0029	0.0003 $\pm$ 0.0001	0.0054 $\pm$ 0.0030	0.0001 $\pm$ 0.0000
August <sup>a</sup>	0.0203 $\pm$ 0.0036	0.0001 $\pm$ 0.0000	0.0083 $\pm$ 0.0027	0.0000 $\pm$ 0.0000
September <sup>a</sup>	0.0429 $\pm$ 0.0042	0.0013 $\pm$ 0.0002	0.0147 $\pm$ 0.0028	0.0008 $\pm$ 0.0001
October	0.0256 $\pm$ 0.0034	0.0001 $\pm$ 0.0000	0.0096 $\pm$ 0.0034	0.0001 $\pm$ 0.0000
November	0.0152 $\pm$ 0.0035 <sup>b</sup>	0.0001 $\pm$ 0.0000	0.0148 $\pm$ 0.0033 <sup>b</sup>	0.0001 $\pm$ 0.0000
December	0.0498 $\pm$ 0.0063 <sup>c</sup>	0.0016 $\pm$ 0.0003	0.0252 $\pm$ 0.0039 <sup>c</sup>	0.0013 $\pm$ 0.0002
Year to Date	0.3814 $\pm$ 0.0551	0.0016 $\pm$ 0.0003	0.2426 $\pm$ 0.0488	0.0013 $\pm$ 0.0002
<b>1993</b>				
January	0.0296 $\pm$ 0.0040 <sup>d</sup>	0.0006 $\pm$ 0.0001	0.0006 $\pm$ 0.0012 <sup>d</sup>	0.0000 $\pm$ 0.0000

a The data for some locations were missing because of failure of Quality Assurance Criteria and were not available because no additional sample remained for analysis. Best estimates of release activities for these samples were included in the January Monthly Environmental Report.

b The November data for 10 plutonium and 5 americium locations are missing because of failure of Quality Assurance Criteria. The samples are being rerun.

c The December data for 1 plutonium and 5 americium locations are missing because of failure of Quality Assurance Criteria. The samples are being rerun.

d Incomplete laboratory analysis.

**Table 2****Uranium Airborne Effluent Data**

	Uranium-233, -234 (12/17/92 - 1/15/93)				Uranium-238 (12/17/92 - 1/15/93)			
Month	Release ( $\mu\text{Ci}$ )		C Maximum ( $\text{pCi}/\text{m}^3$ )		Release ( $\mu\text{Ci}$ )		C Maximum ( $\text{pCi}/\text{m}^3$ )	
1992								
January	-0.0059	± 0.0073	0.0001	± 0.0000	0.0294	± 0.0081	0.0003	± 0.0001
February <sup>a</sup>	0.0229	± 0.0089	0.0001	± 0.0000	0.0737	± 0.0096	0.0004	± 0.0001
March	0.0294	± 0.0088	0.0001	± 0.0000	0.0642	± 0.0094	0.0007	± 0.0002
April	0.0266	± 0.0092	0.0000	± 0.0000	0.0505	± 0.0095	0.0001	± 0.0000
May	0.0110	± 0.0085	0.0000	± 0.0000	0.0462	± 0.0087	0.0001	± 0.0000
June	0.0057	± 0.0076	0.0001	± 0.0000	0.0321	± 0.0082	0.0001	± 0.0000
July	0.0031	± 0.0080	0.0000	± 0.0000	0.0171	± 0.0083	0.0003	± 0.0001
August	0.0098	± 0.0115	0.0001	± 0.0000	0.0316	± 0.0124	0.0001	± 0.0001
September <sup>a</sup>	0.0315	± 0.0103	0.0004	± 0.0001	0.0990	± 0.0175	0.0023	± 0.0005
October	0.0468	± 0.0083	0.0001	± 0.0000	0.0663	± 0.0090	0.0002	± 0.0001
November	0.1077	± 0.0125 <sup>b</sup>	0.0073	± 0.0012	0.0468	± 0.0067 <sup>b</sup>	0.0001	± 0.0000
December	0.0761	± 0.0103 <sup>c</sup>	0.0039	± 0.0006	0.0382	± 0.0083 <sup>c</sup>	0.0002	± 0.0001
Year to Date	0.3717	± 0.1112	0.0073	± 0.0012	0.5951	± 0.1157	0.0023	± 0.0005
1993								
January	0.0070	± 0.0032 <sup>d</sup>	0.0001	± 0.0000	0.0168	± 0.0037 <sup>d</sup>	0.0004	± 0.0001

a The data for some locations were missing because of failure of Quality Assurance Criteria and were not available because no additional sample remained for analysis. Best estimates of release activities for these samples are included in this January Monthly Environmental Report.

b The November data for 2 uranium locations were higher than normal. The results have been included, though the samples are being rerun.

c The December data for 4 uranium locations are missing because of failure of Quality Assurance Criteria. The samples are being rerun.

d Incomplete laboratory analysis.

**Table 3****Tritium and Beryllium Airborne Effluent Data**

<b>Month</b>	<b>Tritium (H-3)</b> <b>(12/30/92 - 1/29/93)</b>		<b>Beryllium</b> <b>(12/17/92 - 1/15/93)</b>	
	<b>Release (mCi)</b>	<b>C Maximum (pCi/m<sup>3</sup>)</b>	<b>Release (grams)</b>	<b>C Maximum (ug/m<sup>3</sup>)</b>
<b>1992</b>				
January	0.733	34 ± 9	0.0472 ± 0.0034	0.00047
February	0.572	41 ± 14	0.0484 ± 0.0034	0.00034
March	0.391	39 ± 7	0.0606 ± 0.0046	0.00066
April	0.012	23 ± 5	0.0850 ± 0.0059	0.00052
May	0.155	24 ± 7	0.0950 ± 0.0068	0.00043
June	0.261	22 ± 7	0.0657 ± 0.0049	0.00023
July	0.134	27 ± 47	0.0444 ± 0.0028	0.00029
August	0.171	36 ± 5	0.0248 ± 0.0018 <sup>a</sup>	0.00026
September	0.373	38 ± 16	0.0358 ± 0.0034	0.00027
October	0.055	117 ± 11	0.0550 ± 0.0037	0.00026
November	0.684	80 ± 7	0.0376 ± 0.0026	0.00019
December	0.257	67 ± 10	0.0240 ± 0.0016	0.00015
Year to date	3.799	117 ± 11	0.6236 ± 0.0449	0.00066
<b>1993</b>				
January	0.187	51 ± 7	b	

*NOTE: Beryllium measured at the remaining 44 locations was below the screening level of 0.1 gram per month. Beryllium emissions from Rocky Flats Plant are regulated by the State of Colorado under Colorado Air Quality Control Regulation #8. The limit for beryllium air emissions is 10 grams per stationary source in a 24-hour period. No blank corrections are made to any beryllium data.*

a The data for one location was not available. Best estimate of release activity for this sample is included in this January Monthly Environmental Report.

b Incomplete laboratory analysis.

## 2.2 Ambient

Ambient air samplers monitor plutonium concentrations in air in the surrounding environment. This monitoring is performed in accordance with DOE Order 5400.1. The data are used to determine the air-inhalation dose to the public for comparison with the DOE standard of 100 millirem per year effective dose equivalent from all modes of exposure from routine plant operations.

Samplers are designated in three categories by their proximity to the main facilities area. Twenty-five onsite samplers are located within RFP, generally downwind of RFP production facilities areas and near areas of known plutonium contamination. Fourteen perimeter samplers border RFP along major highways on the north (Highway 128), east (Indiana Street), south (Highway 72), and west (Highway 93) (Figure 2). Fourteen community samplers are located in metropolitan areas adjacent to RFP (Figure 3).

Samplers operate continuously at a volumetric flow rate of approximately 0.84 cubic meters per minute, collecting air particulates on 20- by 25-centimeter fiberglass filters. Manufacturer's test specifications rate this filter media to be 99.97 percent efficient for relevant particle sizes under conditions typically encountered in routine ambient air sampling.

Ambient air filters are collected biweekly and composited monthly by location before isotopic analysis. All routine ambient air filters are analyzed for plutonium-239 and -240.

Tables 4 through 6 summarize environmental monitoring data from the RFP ambient air sampling network.

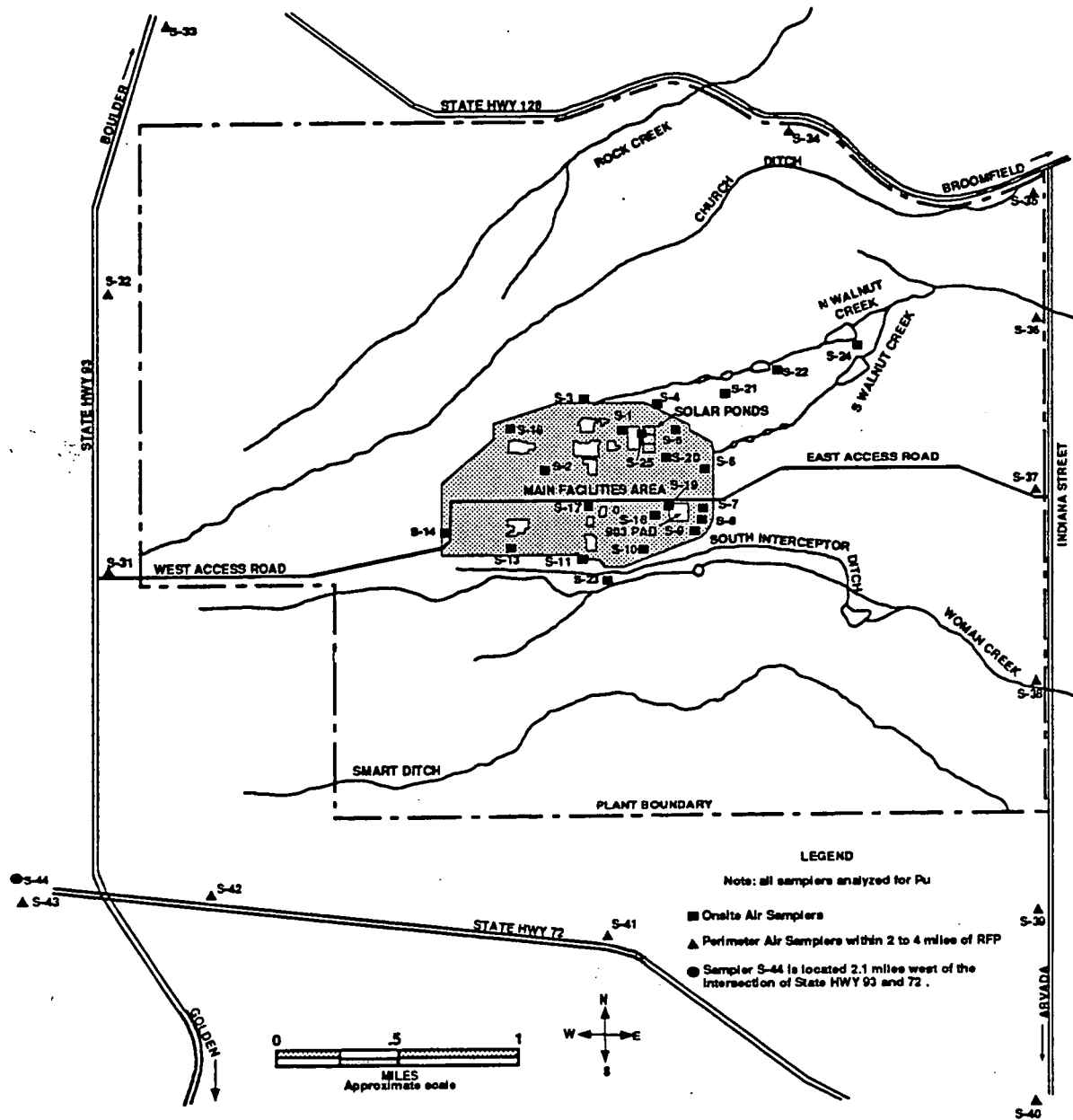


Figure 2: Location of Onsite and Perimeter Air Samplers



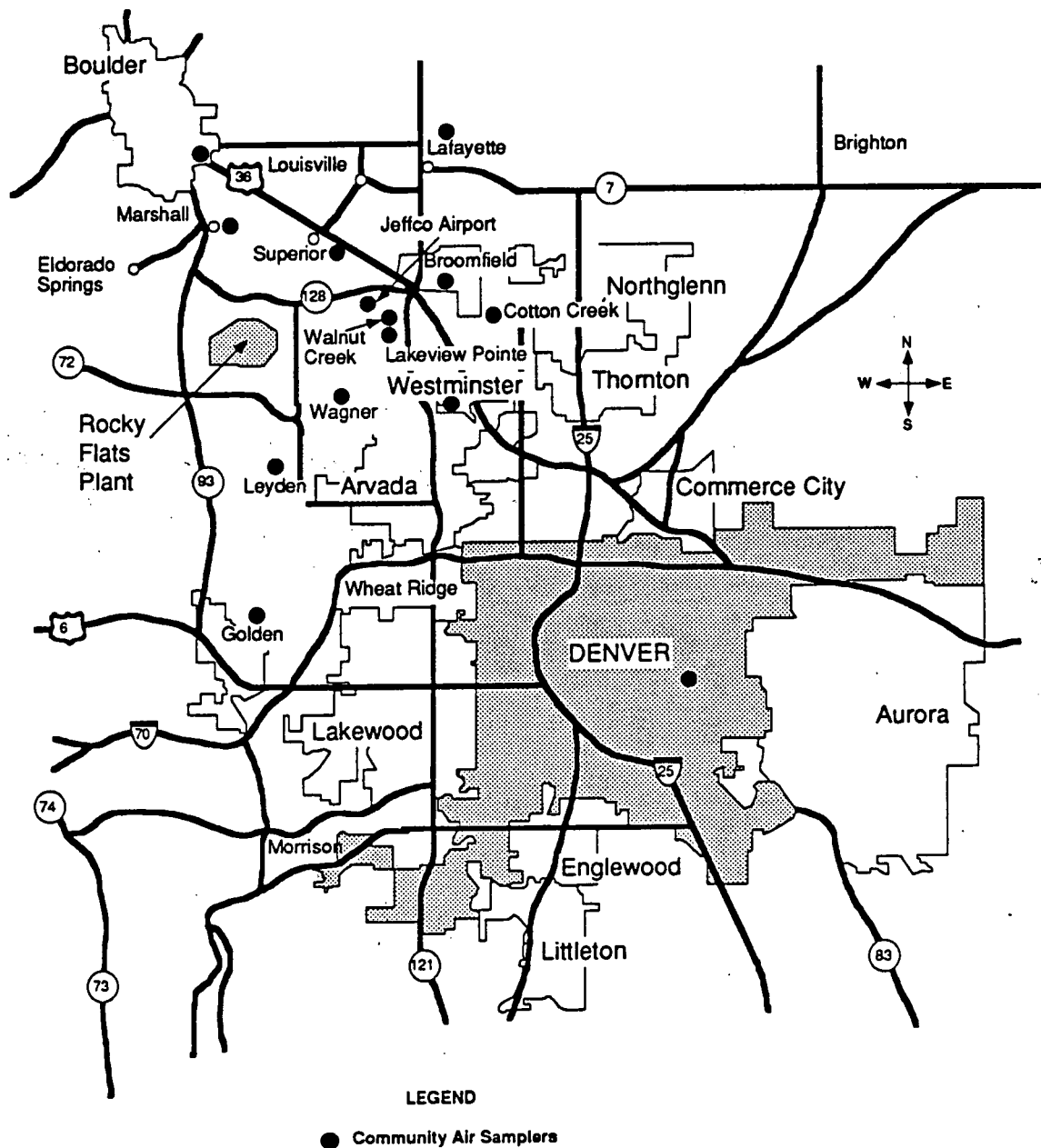


Figure 3: Location of Community Air Samplers

**Table 4****Plutonium Concentrations in Ambient Air for Onsite Samplers****(12/21/92 - 1/18/93)**

<b><u>Location</u></b>	<b><u>Volume (m<sup>3</sup>)</u></b>	<b><u>Plutonium Concentration (pCi/m<sup>3</sup>)</u></b>	<b><u>± 95 percent Confidence Interval (pCi/m<sup>3</sup>)</u></b>
S-01 <sup>a</sup>			
S-02 <sup>a</sup>			
S-03 <sup>a</sup>			
S-04 <sup>a</sup>			
S-05 <sup>a</sup>			
S-06 <sup>a</sup>			
S-07 <sup>a</sup>			
S-08 <sup>a</sup>			
S-09 <sup>a</sup>			
S-10 <sup>a</sup>			
S-11 <sup>a</sup>			
S-13 <sup>a</sup>			
S-14 <sup>a</sup>			
S-16 <sup>a</sup>			
S-17 <sup>a</sup>			
S-18 <sup>a</sup>			
S-19 <sup>a</sup>			
S-20 <sup>a</sup>			
S-21 <sup>a</sup>			
S-22 <sup>a</sup>			
S-23 <sup>a</sup>			
S-24 <sup>a</sup>			
S-25 <sup>a</sup>			
S-81 <sup>a</sup>			

<sup>a</sup> Incomplete laboratory analysis.

**Table 5****Plutonium Concentrations in Ambient Air for Perimeter Samplers****(12/22/92 - 1/19/93)**

<b><u>Location</u></b>	<b>Volume (m<sup>3</sup>)</b>	<b>Plutonium Concentration (pCi/m<sup>3</sup>)</b>	<b>± 95 percent Confidence Interval (pCi/m<sup>3</sup>)</b>
S-31 <sup>a</sup>			
S-32 <sup>a</sup>			
S-33 <sup>a</sup>			
S-34 <sup>a</sup>			
S-35 <sup>a</sup>			
S-36 <sup>a</sup>			
S-37 <sup>a</sup>			
S-38 <sup>a</sup>			
S-39 <sup>a</sup>			
S-40 <sup>a</sup>			
S-41 <sup>a</sup>			
S-42 <sup>a</sup>			
S-43 <sup>a</sup>			
S-44 <sup>a</sup>			

<sup>a</sup> Incomplete laboratory analysis.

**Table 6****Plutonium Concentrations in Ambient Air for Community Samplers****(12/13/92 - 1/20/93)**

<b><u>Location</u></b>	<b><u>Community Name</u></b>	<b><u>Volume (m<sup>3</sup>)</u></b>	<b><u>Plutonium Concentration (pCi/m<sup>3</sup>)</u></b>	<b><u>± 95 percent Confidence Interval (pCi/m<sup>3</sup>)</u></b>
S-51 <sup>a</sup>	Marshall			
S-52 <sup>a</sup>	Jeffco Airport			
S-53 <sup>a</sup>	Superior			
S-54 <sup>a</sup>	Boulder			
S-55 <sup>b</sup>	Lafayette			
S-56 <sup>a</sup>	Broomfield			
S-57 <sup>b</sup>	Walnut Creek			
S-58 <sup>a</sup>	Wagner			
S-59 <sup>a</sup>	Leyden			
S-60 <sup>a</sup>	Westminster			
S-61 <sup>c</sup>	Denver			
S-62 <sup>a</sup>	Golden			
S-68 <sup>a</sup>	Lakeview Pointe			
S-73 <sup>a</sup>	Cotton Creek			

<sup>a</sup> Incomplete laboratory analysis.

<sup>b</sup> This sampler was damaged beyond repair and must be replaced.

<sup>c</sup> Sampler S-61 located in Denver was inoperative during this period. This sampler has been temporarily removed because of construction activities on the building where it is installed.

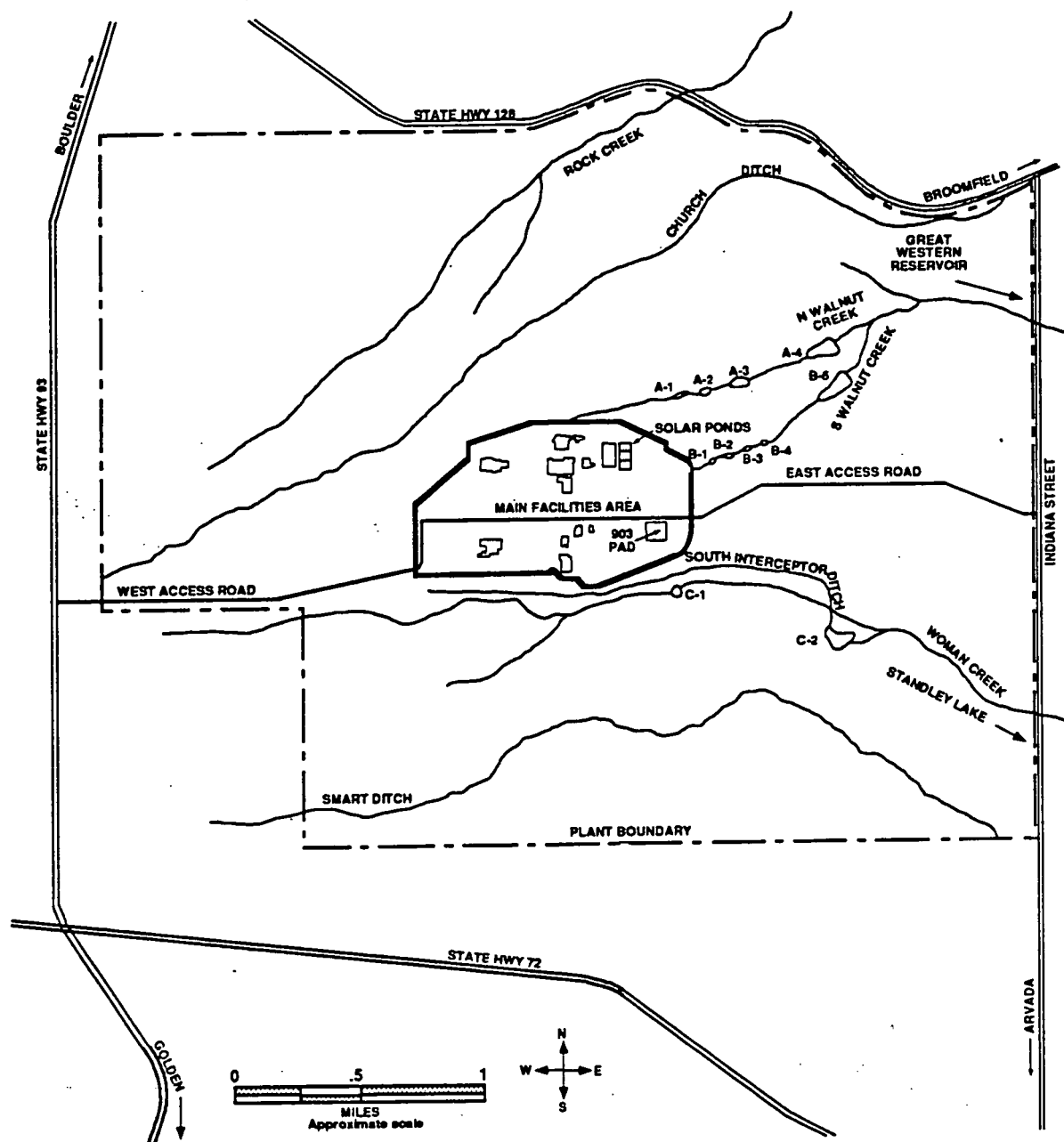
### **3. Water**

#### **3.1 Radionuclide**

RFP samples for and analyzes radionuclides that may be present in the plant surface water control ponds and drinking water reservoirs. Radionuclide standards for discharge of surface water effluents are given in DOE Order 5400.5, "Radiation Protection of the Public and the Environment." In addition, the Colorado Water Quality Control Commission has issued stream segment standards for drainages downstream of RFP. These standards address both radioactive and nonradioactive parameters.

Water sampling is performed at several locations at RFP. These include ponds A-4, B-5, C-1, and C-2 as well as Walnut Creek at Indiana Street. Daily samples are collected during discharges or periods of flow for these locations, and composited into weekly samples. Analyses are then performed for plutonium, americium, and uranium isotopic concentrations.

Water sampling results for radioactive constituents are given in Tables 7 through 10.



Note: Stream flow in the Rocky Flats area is to the east.

Figure 4: Holding Pond and Liquid Effluent Water Courses

**Table 7**

**Onsite Water Sample Results - Plutonium and Americium**

Holding Pond Outfall (pCi/l)			
<u>Location</u>	<u>Plutonium-239, -240</u>		<u>Americium-241</u>
<u>Pond A-4</u>			
No discharge			
Volume weighted average concentration			
 <u>Pond B-5</u> - No discharge			
 <u>Pond C-1</u>			
01/02/93 - 01/08/93	0.001	± 0.001	0.000 ± 0.002
01/09/93 - 01/15/93		a	a
01/16/93 - 01/22/93		a	a
01/23/93 - 01/29/93		a	a
Average concentration		a	a
 <u>Pond C-2</u> - No discharge			
 <u>Walnut Creek at Indiana</u> No Flow			
Volume weighted average concentration			

a    Incomplete laboratory analysis.

**Table 8****Onsite Water Sample Results - Uranium**

Holding Pond Outfall (pCi/l)						
Location	<u>Uranium-233, -234</u>			<u>Uranium-238</u>		
<u>Pond A-4</u> - No discharge						
Volume weighted average concentration						
<u>Pond B-5</u> - No discharge						
<u>Pond C-1</u>						
01/02/93 - 01/08/93	0.81	±	0.08	0.62	±	0.06
01/09/93 - 01/15/93		a			a	
01/16/93 - 01/22/93		a			a	
01/23/93 - 01/29/93		a			a	
Average concentration		a			a	
<u>Pond C-2</u> - No discharge						
<u>Walnut Creek at Indiana</u> - No Flow						

Volume weighted average concentration

a Incomplete laboratory analysis.



**Table 9**

**Onsite Water Sample Results - Tritium**

Tritium (pCi/l)

<u>Location</u>	<u>Number of Samples</u>	<u>C Minimum</u>	<u>C Maximum</u>	<u>C Average</u>
Pond C-1	4	-160 ± 90	40 ± 100	-80 ±90

### 3.2 Nonradionuclide

RFP conducts sitewide surface water sampling programs to monitor discharges from detention ponds, evaluate potential contaminant releases, and characterize baseline water quality. Nonradioactive parameters requirements for this monitoring are derived from the RFP EPA National Pollutant Discharge Elimination System (NPDES) permit as modified in March 1991, by a Federal Facilities Compliance Agreement (FFCA). The NPDES/FFCA permit sets limits for nonradioactive pollutants in effluent water from federal facilities.

The EPA has issued to the RFP an NPDES permit for control of surface water discharges. The RFP NPDES permit establishes effluent limitations for seven surface water discharge points, which may discharge into drainages leading off of the RFP.

Water sampling results associated with the NPDES/FFCA permit are reported in Table 10. Applicable NPDES/FFCA limits are included in Table 10 for comparison. Monitoring results for which no limits have been established under the NPDES/FFCA are reported in Table 11. Analytical results for nonradioactive parameters in water at Walnut Creek at the Indiana Street location are summarized in Table 12.

**Table 10**

**NPDES/FFCA Permit Water Sample Results**

**Discharge 001-A (Pond B-3)** Discharged continuously from 01/01/93 - 01/31/93.

<u>Parameters</u>		<u>Measured 30-Day Average</u>	<u>Limit 30-Day Average</u>	<u>Measured Max. 7-Day Average</u>	<u>Limit Max. 7-Day Average</u>
Nitrate	mg/l	0.7	10	1	20
Total Residual Chlorine	mg/l		<u>Measured Maximum</u> 0.09	<u>Limit Maximum</u> 0.5	

**Discharge 001-B (Sewage Treatment Plant)** Discharged continuously from 01/01/93 - 01/31/93.

<u>Parameters</u>		<u>Measured 30-Day Average</u>	<u>Limit 30-Day Average</u>	<u>Measured Maximum</u>	<u>Limit Maximum</u>
CBOD <sub>5</sub>	mg/l	2	10	6	25
Total Phosphorus	mg/l	0.7	8	1.5	12
Total Chromium	mg/l	0.0027	0.05	0.003	0.10
		<u>Measured 30-Day Average</u>	<u>Limit 30-Day Average</u>	<u>Measured Max. 7-Day Average</u>	<u>Limit Max. 7-Day Average</u>
Fecal Coliforms	#/100 ml	3(Geometric)	200 (Geometric)	38(Geometric)	400 (Geometric)
Total Suspended Solids	mg/l	9	30	1	45
		<u>Measured Minimum</u>	<u>Limit Minimum</u>	<u>Measured Maximum</u>	<u>Limit Maximum</u>
pH	SU	6.8	6.0	7.5	9.0
		<u>Observed Sheen</u>	<u>Limit Sheen</u>		
Oil and Grease		No visual	No visual		

**Discharge 002 (Pond A-3)**  
Pond discharged continuously 01/19/93 - 01/22/93

<u>Parameters</u>		<u>Measured 30-Day Average</u>	<u>Limit 30-Day Average</u>	<u>Measured Maximum</u>	<u>Limit Maximum</u>
Nitrates as N	mg/l	2.6	10	4.4	20
		<u>Measured Minimum</u>	<u>Limit Minimum</u>	<u>Measured Maximum</u>	<u>Limit Maximum</u>
pH	SU	7.2	6.0	7.7	9.0

**Table 10**

**NPDES/FFCA Permit Water Sample Results (Continued)**

*Discharge 003 (RO Pilot Plant) and Discharge 004 (RO Plant) are inactive outfalls and will be eliminated from the new NPDES permit.*

**Discharge 005 (Pond A-4)** No discharge.

<u>Parameters</u>		<u>Measured Maximum</u>	<u>Limit Maximum</u>
Total Chromium	mg/l	<0.0024	0.05

**Discharge 006 (Pond B-5)** No discharge.

<u>Parameters</u>		<u>Measured 30-Day Average</u>	<u>Limit 30-Day Average</u>	<u>Measured Max. 7-Day Maximum</u>	<u>Limit Max. 7-Day Maximum</u>
Nitrate as Na <sup>+</sup>	mg/l		10		20
			<u>Measured Maximum</u>	<u>Limit Maximum</u>	
Total Residual Chlorine <sup>a</sup>	mg/l			0.5	
Total Chromium	mg/l			0.05	

**Discharge 007 (Pond C-2)** No discharge.

<u>Parameters</u>		<u>Measured Maximum</u>	<u>Limit Maximum</u>
Total Chromium	mg/l		0.05

<sup>a</sup> These parameters are measured only in the event that Waste Water Treatment Plant effluent bypasses Pond B-3 and flows directly into Pond B-5.

**Table 11**

**NPDES/FFCA Effluent Monitoring**

**Discharge 001-A (Pond B-3)** Discharged continuously from 01/01/93-01/31/93.

<u>Parameters</u>		<u>Measured Maximum</u>	<u>Measured 30-Day Average</u>
BOD <sub>5</sub>	mg/l	8	5
CBOD <sub>5</sub>	mg/l	6	2.3
Total Suspended Solids	mg/l	16	10.5

**Discharge 001-B (Sewage Treatment Plant [STP])** Discharged continuously from 01/01/93-01/31/93.

<u>Parameters</u>		<u>Measured Maximum</u>	<u>Measured 30-Day Average</u>
Nitrate as N	mg/l	1.1	0.64
Total Residual Chlorine	mg/l	0.07	0.02

Whole Effluent Toxicity<sup>a</sup> Reported quarterly; data reported 12/92  
 Ceriodaphnia % Eff to LC<sub>50</sub>:  
 Fathead Minnows % EFF to LC<sub>50</sub>:

<u>Metals</u>		<u>Measured 30-Day Average</u>
Metals	ug/l	
Antimony		<22
Arsenic		<1.1
Beryllium		<0.8
Cadmium		<3.2
Copper		<3.3
Iron		121
Lead		<0.9
Manganese		22
Mercury		<0.2
Nickel		<15
Silver		<3.1
Zinc		43

Metals were sampled on 01/08/93 and 01/13/93

		<u>PQL<sup>b</sup></u>	<u>Concentrations above PQL</u>	
Volatile Organic Compounds (VOCs)	ug/l			
Chloroform		5 ug/l	5 ug/l	sampled 01/06/93
Chloroform		5 ug/l	5 ug/l	sampled 01/20/93

## Table 11

### NPDES/FFCA Effluent Monitoring (Continued)

*Discharge 003 (Reverse Osmosis Pilot Plant) and Discharge 004 (Reverse Osmosis Plant) are inactive outfalls and will be eliminated from the new NPDES permit.*

**Discharge 005 (Pond A-4) No Discharge**

**Whole Effluent Toxicity<sup>a</sup>**

Ceriodaphnia      % EFF to LC<sub>50</sub>:

Fathead Minnows      % EFF to LC<sub>50</sub>:

**Discharge 006 (Pond B-5) - No Discharge**

**Whole Effluent Toxicity<sup>a</sup>**

Ceriodaphnia      % EFF to LC<sub>50</sub>:

Fathead Minnows      % EFF to LC<sub>50</sub>:

**Discharge 007 (Pond C-2) - No Discharge**

**Whole Effluent Toxicity<sup>a</sup>**

Ceriodaphnia      % EFF to LC<sub>50</sub>:

Fathead Minnows      % EFF to LC<sub>50</sub>:

- a Results for whole effluent toxicity are given in percentage of effluent sample that will cause mortality to half the test result organisms within the time frame of the test. For example, >100 percent indicates that 100 percent pure effluent did not cause acute toxicity to at least half of the organisms. A lower percentage LC<sub>50</sub> (lethal concentration to 50 percent of test organisms) indicates a greater toxic effect since less of the sample is required to observe a sufficiently extensive adverse effect.
- b PQL is the Practical Quantitation Limit. It is equal to ten times the Method Detection Limit and represents the quantity at which 70 percent of laboratories can report in the 95 percent confidence interval.

**Table 12**

**Water Sample Results, Nonradioactive Parameters**

Walnut Creek at Indiana Street  
No Flow

<u>Parameters</u>		<u>Number of Samples</u>	<u>C Minimum</u>	<u>C Maximum</u>	<u>C Average</u>
pH	SU				
Nitrates as N	mg/l				

### **3.3 Flow**

Daily flow data for surface water from the two plant drainage systems (Walnut Creek and Woman Creek) are given in Tables 13 and 14. The current NPDES/FFCA permit requires flow measurement for terminal ponds when discharged offsite (A-4, B-5, and C-2). Other flow data are reported for informational purposes.

Daily flow data for water transferred from Pond B-5 to Pond A-4, for subsequent discharge offsite, are given in Table 15. Meteorological data are given in Tables 16 and 17.



**Table 13****Daily Flow Data Recorded at the Walnut Creek at Indiana Gaging Station, Ponds A-4 and B-5**

<u>Date</u>	<u>Walnut Creek at Indiana (Gallons)</u>	<u>Pond A-4 (Gallons)</u>	<u>Pond B-5 (Gallons)</u>
01/01/93	No Flow	No Discharge	No Discharge
01/02/93			
01/03/93			
01/04/93			
01/04/93			
01/05/93			
01/06/93			
01/07/93			
01/08/93			
01/09/93			
01/10/93			
01/11/93			
01/12/93			
01/13/93			
01/14/93			
01/15/93			
01/16/93			
01/17/93			
01/18/93			
01/19/93			
01/20/93			
01/21/93			
01/22/93			
01/23/93			
01/24/93			
01/25/93			
01/26/93			
01/27/93			
01/28/93			
01/29/93			
01/30/93			
01/31/93	No Flow	No Discharge	No Discharge
Total	No Flow	No Discharge	No Discharge

**Table 14****Daily Flow Data Recorded at Ponds C-1 and C-2 (Woman Creek)**

<u>Date</u>	<u>Pond C-1 (Gallons)</u>	<u>Pond C-2 (Gallons)</u>
01/01/93	179,000	No Discharge
01/02/93	231,000	
01/03/93	217,000	
01/04/93	143,000	
01/05/93	123,000	
01/06/93	100,000	
01/07/93	103,000	
01/08/93	95,000	
01/09/93	96,000	
01/10/93	105,000	
01/11/93	111,000	
01/12/93	106,000	
01/13/93	88,000	
01/14/93	86,000	
01/15/93	115,000	
01/16/93	196,000	
01/17/93	218,000	
01/18/93	179,000	
01/19/93	154,000	
01/10/93	156,000	
01/21/93	363,000	
01/22/93	459,000	
01/23/93	262,000	
01/24,93	151,000	
01/25/93	162,000	
01/26/93	285,000	
01/27/93	280,000	
01/28/93	212,000	
01/29/93	175,000	
01/30/93	182,000	
01/31/93	228,000	No Discharge
Total	5,560,000	No Discharge

**Table 15****Daily Transfer Flow Data Recorded for Pond B-5 to Pond A-4**

<u>Date</u>	<u>Pond B-5 to Pond A-4 (Gallons)</u>
01/01/93	No Transfer
01/02/93	
01/03/93	
01/04/93	
01/05/93	
01/06/93	
01/07/93	
01/08/93	
01/09/93	
01/10/93	
01/11/93	
01/12/93	
01/13/93	
01/14/93	
01/15/93	
01/16/93	
01/17/93	No Transfer
01/18/93	1,215,000
01/19/93	1,188,000
01/20/93	1,175,000
01/21/93	1,164,000
01/22/93	1,112,000
01/23/93	1,027,000
01/24/93	943,000
01/25/93	937,000
01/26/93	No Transfer
01/27/93	
01/28/93	
01/29/93	
01/30/93	
01/31/93	No Transfer
Total	8,761,000

## 4. Meteorology and Climatology

Meteorological data are routinely collected on the plantsite from instrumentation installed on a 61-meter (200-foot) tower located in the west buffer zone. Meteorological data recovery was nearly 100 percent for January. Table 16 is the January 1993 summary of the percent frequency of wind directions (16 compass points) divided into four wind-speed categories. The compass point designations indicate the true bearing when facing against the wind. These frequency values are represented graphically in the accompanying wind rose. The wind rose vectors also represent the bearing against the wind (i.e., wind along each vector blows toward the center).

Winds at RFP generally occur from the west through northwest, especially when speeds are greater than 3 m/s (6.7 mph). At lighter wind speeds less than 3 m/s (6.7 mph), the distribution of wind direction is more even. Wind speeds greater than 7 m/s (15.7 mph) from the east through south occur infrequently. The distribution of winds during January 1993 showed the predominance of strong, large scale winds from the west, northwest during the month. Some of the north to north-northeasterly winds were caused by Arctic high pressure systems.

January was colder and drier than normal. The month's only significant Arctic air mass arrived on January 7. A storm combined with upslope winds to produce 2.2 inches (5.6 cm) of snow on January 8 and 9. The low temperatures were below 0 degrees Fahrenheit (°F) on January 8, 9, and 11, including -4 °F (-20 degrees centigrade [°C]) on January 10, the coldest so far this winter. The Arctic air mass caused an inversion and poor atmospheric mixing over the region during the second week. A high pressure system prevailed over the mountain states during the second half of the month, preventing any significant precipitation. Strong, upper-level winds caused Chinook winds on January 20 to 23, with peak gusts exceeding 62 mph (28 m/s) each day.

The mean wind speed during January was 8.5 mph (3.8 m/s). The peak gust during the month occurred on January 21, reaching 75 mph (34 m/s). The mean temperature was 28.0 °F (-2.2 °C), or about 3 °F (1.7 °C) below normal.

Precipitation was light, with only 0.13 inches (0.33 cm) of water equivalent falling. The normal January precipitation is 0.36 inches (0.91 cm). Snowfall was also light, totalling 3.0 inches (7.6 cm), or about 1/3 of normal. Seasonal snowfall has now slipped to only slightly above normal (37 inches [94 cm]) through January.

**Table 16****Rocky Flats Plant Wind Direction Frequency (Percent) by Four Wind-Speed Classes****(Fifteen-Minute Averages - January 1993)**

	<u>Calm</u>	<u>1-3</u> <u>(m/s)</u>	<u>3-7</u> <u>(m/s)</u>	<u>7-15</u> <u>(m/s)</u>	<u>&gt;15</u> <u>(m/s)</u>	<u>Total</u>
N	-	4.54	3.90	0.67	0.00	9.11
NNE	-	4.97	1.68	0.00	0.00	6.65
NE	-	3.02	1.04	0.00	0.00	4.06
ENE	-	1.92	0.47	0.00	0.00	2.39
E	-	1.95	0.34	0.00	0.00	2.29
ESE	-	1.98	0.44	0.00	0.00	2.42
SE	-	2.86	1.44	0.00	0.00	4.30
SSE	-	2.89	1.92	0.00	0.00	4.81
S	-	3.26	1.81	0.24	0.00	5.31
SSW	-	2.76	1.85	0.10	0.00	4.71
SW	-	2.45	2.08	0.20	0.00	4.73
WSW	-	2.62	1.65	0.37	0.00	4.64
W	-	3.36	1.38	1.14	0.34	6.22
WNW	-	5.14	2.59	6.01	1.68	15.42
NW	-	4.81	3.29	1.78	0.03	9.91
NNW	-	5.11	3.43	0.50	0.00	9.04
TOTAL	3.99	53.64	29.31	11.01	2.05	100.00

Table 17

## Climatic Summary

Date	TEMPERATURE (deg. F)			DEW- POINT (deg. F)	WIND SPEED (mph)		PRESS. (mb)	SOLAR (kW-h/m2)	WATER- EQUIV.- PRECIP. (Inches)		SNOW (Inches)
	High	Low	Mean	Mean	Peak gust Mean	(1 sec)	Mean	Total	Peak Total	(15 min)	Total
01/01	52.2	17.2	34.7	11.3	4.9	13.2	809	2.27	0.00	0.00	0.0
01/02	52.5	35.4	44.0	14.5	7.8	23.7	801	2.22	0.00	0.00	0.0
01/03	41.4	9.3	25.4	7.3	7.8	25.1	802	0.50	0.03	0.01	0.4
01/04	33.6	7.0	20.3	0.1	5.1	16.8	806	2.40	0.00	0.00	0.0
01/05	32.4	9.9	21.2	-2.2	7.4	18.3	808	2.12	0.00	0.00	0.0
01/06	34.5	10.8	22.7	0.3	5.1	13.6	807	2.36	0.00	0.00	0.0
01/07	24.8	12.2	18.5	2.3	6.3	18.1	804	0.86	0.00	0.00	0.0
01/08	16.3	5.9	11.1	3.6	8.1	30.2	799	0.78	0.04	0.01	1.2
01/09	8.2	-2.6	2.8	-8.3	2.9	10.1	808	2.79	0.03	0.01	1.0
01/10	13.5	-4.2	4.7	-9.6	2.9	8.5	805	2.96	0.00	0.00	0.0
01/11	34.9	2.8	18.9	0.5	9.2	53.9	798	2.51	0.00	0.00	0.0
01/12	26.8	-3.1	11.9	-5.8	7.8	41.8	806	2.44	0.00	0.00	0.0
01/13	18.5	4.5	11.5	-4.5	4.9	14.3	809	2.15	0.00	0.00	0.0
01/14	41.9	10.8	26.4	7.2	4.7	27.1	806	2.40	0.00	0.00	0.0
01/15	47.3	33.6	40.5	13.1	12.1	43.4	808	2.32	0.00	0.00	0.0
01/16	47.8	20.8	34.3	10.6	13.4	47.6	808	2.60	0.00	0.00	0.0
01/17	32.7	19.9	26.3	10.8	4.3	16.8	807	1.95	0.00	0.00	0.0
01/18	34.3	18.1	26.2	13.3	4.9	12.1	809	2.63	0.00	0.00	0.0
01/19	35.2	13.3	24.3	9.7	4.3	12.8	806	0.61	0.02	0.02	0.3
01/20	46.9	32.5	39.7	9.0	27.7	62.2	806	2.71	0.00	0.00	0.0
01/21	50.4	33.3	41.9	12.9	19.0	75.4	811	2.80	0.00	0.00	0.0
01/22	56.3	32.0	44.2	8.8	20.4	62.2	805	2.11	0.01	0.01	0.1
01/23	34.2	14.5	24.4	1.4	12.5	66.0	811	2.58	0.00	0.00	0.0
01/24	37.2	11.3	24.3	1.2	10.3	36.5	812	1.53	0.00	0.00	0.0
01/25	47.3	30.4	38.9	10.2	13.0	38.9	813	2.43	0.00	0.00	0.0
01/26	52.9	32.9	42.9	15.8	6.7	17.0	815	2.91	0.00	0.00	0.0
01/27	55.8	36.5	46.2	9.9	6.9	23.0	812	3.03	0.00	0.00	0.0
01/28	46.4	23.4	34.9	8.4	7.4	21.5	815	1.86	0.00	0.00	0.0
01/29	33.1	20.3	26.7	12.6	4.5	10.7	815	1.28	0.00	0.00	0.0
01/30	46.4	25.3	35.9	9.5	5.1	12.5	818	3.09	0.00	0.00	0.0
01/31	52.7	35.2	44.0	9.5	5.6	14.3	818	3.16	0.00	0.00	0.0

MONTHLY TEMPERATURES				WIND SPEED		PRESS.	SOLAR	PRECIPITATION		SNOW
Mean High	Mean Low	Mean	Dew- point	Mean (mph)	Monthly Max.	Monthly Avg.	Monthly Total	Total	Monthly Max.	Total
38.3	17.7	28.0	5.9	8.5	75.4	808.3	68.36	0.13	0.02	3.0





# Appendix A

## Radiation Standards for Protection of the Public

### Calculation of Potential Plant Contribution to Public Radiation Dose

The primary standards for protection of the public from radiation are based on radiation dose. Radiation dose is a means of quantifying the biological damage or risk of ionizing radiation. The unit of radiation dose is the rem or the millirem (1 rem = 1,000 mrem). Radiation protection standards for the public are annual standards, based on the projected radiation dose from a year's exposure to or intake of radioactive materials.

Radiation dose is a calculated value. It is calculated by multiplying radioactivity concentrations in air and water or on contaminated surfaces by assumed intake rates (for internal exposures) or by exposure times (for external exposure to penetrating radiation), then by the appropriate radiation dose conversion factors. That is:

$$\text{Radiation Dose} = \frac{\text{Radioactivity Concentration} \times \text{Intake Rate/Exposure Time} \times \text{Dose Conversion Factor}}{1}$$

Radioactivity concentrations can be determined either by measurements in the environment or by calculations using computer models. These computer models perform airborne dispersion/dose modeling of measured building radioactivity effluents and estimated diffuse source term emissions (e.g., from resuspension from contaminated soil areas).

Assumed intake rates and dose conversion factors used are based on recommendations of national and international radiation protection advisory organizations, such as the National Council on Radiation Protection and Measurements (NCRP) and the International Commission on Radiological Protection (ICRP).

Radioactive materials of importance in calculating radiation dose to the public from Rocky Flats Plant (RFP) activities include plutonium, uranium, americium, and tritium. Alpha radiation emissions from plutonium, uranium, and americium are primary contributors to the projected radiation dose.

#### DOE Radiation Protection Standards for the Public

##### ICRP-Recommended Standards for all Pathways:

Temporary Increase - 500 mrem/year  
Effective Dose Equivalent  
(with prior approval of DOE EH-2)

Normal Operations - 100 mrem/year  
Effective Dose Equivalent

##### EPA Clean Air Act Standards for the Air Pathway Only:

10 mrem-year Effective Dose  
Equivalent

**DOE Derived Concentration Guides for Radionuclides of Interest at the Rocky Flats Plant**

**Air Inhalation:**

Radionuclide (pCi/m <sup>3</sup> )	DCG
Plutonium-239, -240	0.02

**Water Ingestion:**

Radionuclide	DCG (pCi/l)
Plutonium-239, -240	30
Americium-241	30
Uranium-233, -234	500
Uranium-238	600
Hydrogen-3 (Tritium)	2,000,000

Potential public radiation dose commitments, which could have resulted from plant operations and from background (i.e., non-Plant) contributions, are calculated from average radionuclide concentrations measured at the Department of Energy (DOE) property boundary and in surrounding communities. Inhalation and water ingestion are the principal potential pathways of human exposure.

On February 8, 1990, DOE adopted DOE Order 5400.5, "Radiation Protection of the Public and the Environment," a radiation protection standard for DOE environmental activities (US 90). This standard incorporates guidance from the International Commission on Radiological Protection (ICRP), as well as from the Environmental Protection Agency Clean Air Act air emission standards (as implemented in 40 CFR 61, Subpart H). Included in DOE Order 5400.5 is a revision of the dose limits for members of the public. Tables of radiation dose conversion factors currently used for calculating dose from intakes of radioactive materials were issued in July 1988 (US88a, US88b). The dose factors are based on the ICRP Publications 30 and 48 methodology and biological models for radiation dosimetry. The DOE Order 5400.5 and the dose conversion factor tables are used for assessment of any potential RFP contribution to public radiation dose. On December 15, 1989, EPA published revised Clean Air Act air emission standards for DOE facilities (US89). DOE radiation standards for protection of the public are given in this Appendix and include the December 15, 1989, EPA Clean Air Act air pathway standards.

**DOE Derived Concentration Guides**

Secondary radioactivity concentration guides can be calculated from the primary radiation dose standards and used as comparison values for measured radioactivity concentrations. DOE provides tables of these "Derived Concentration Guides" - in Order 5400.5. Derived Concentration Guides (DCGs) are the concentrations that would result in an effective dose equivalent of 100 mrem from one year's chronic exposure or intake. In calculating air inhalation DCGs, DOE assumes that the exposed individual inhales 8,400 cubic meters of air at the calculated DCG during the year. Ingestion DCGs assume a water intake of 720 liters at the calculated DCG for the year. The table on page 40 lists the most restrictive air and water DCGs for the principal radionuclides of interest at the RFP.

**Compliance with EPA  
Clean Air Act Standards**

To determine compliance with the EPA air emissions standards, measured airborne effluent radioactivity emissions are entered into the EPA-approved atmospheric dispersion/dose calculation computer model, AIRDOS-PC, for calculation of the maximum radiation dose that an individual in the public could receive from the air pathway only.

For comparison with the annual radiation dose standards for protection of the public, the maximum annual effective dose equivalent that a member of the public could receive as a result of RFP activities is typically less than 1 mrem, or less than 1 percent of the recommended annual standard for all pathways.

**Dose Equivalent and Effective Dose Equivalent (EDE)**

Dose equivalent is a calculated value used to quantify radiation dose; it reflects the degree of biological effect from ionizing radiation. Differences in the biological effect of different types of ionizing radiation (e.g., alpha, beta, gamma, or x-rays) are accounted for in the calculation of dose equivalent.

EDE is a calculated value used to allow comparisons of total health risk (based primarily on the risk of cancer mortality) from exposures of different types of ionizing radiation to different body organs. It is calculated by first calculating the dose equivalent to those organs receiving significant exposures, multiplying each organ dose equivalent by a health risk weighting factor, and then summing those products. One millirem EDE from natural background radiation would have the same health risk as one millirem EDE from an artificially produced source of radiation.

## References

US88a DOE/EH-0070, "External Dose-Rate Conversion Factors for Calculation of Dose to the Public," United States Department of Energy, Asst. Secretary for Environment, Safety and Health, July 1988.

US88b DOE/EH-0071, "Internal Dose Conversion Factors for Calculation of Dose to the Public," United States Department of Energy, Asst. Secretary of Environment, Safety and Health, July 1988.

US89 United States Environmental Protection Agency, Code of Federal Regulations 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities," Washington, D.C., December 15, 1989.

US90 United States Department of Energy, DOE Order 5400.5, "Radiation Protection of the Public and the Environment," Washington, D.C., February 8, 1990.

## **Appendix B**

### **National Pollutant Discharge Elimination System/Federal Facilities Compliance Agreement Volatile Organic Compounds**

The following is a list of volatile organic compounds (VOCs) for which monitoring is required by the Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System/Federal Facilities Compliance Agreement (NPDES/FFCA).

<u>Compound</u>	<u>PQL (ug/l)</u>	<u>Compound</u>	<u>PQL (ug/l)</u>
Benzene	5	1,3-dichloropropylene	5
Bromoform	5	Ethylbenzene	5
Methyl bromide	10	Methyl chloride	10
Carbon Tetrachloride	5	Methylene chloride	5
Chlorobenzene	5	1,1,2,2-tetrachloroethane	5
Chlorodibromomethane	5	Tetrachloroethylene	5
Chloroethane	10	Toluene	5
Chloroform	5	1,2-trans-dichloroethylene	5
Dichlorobromomethane	5	1,1,1-trichloroethane	5
1,1-dichloroethane	5	1,1,2-trichloroethane	5
1,2-dichloroethane	5	Trichloroethylene	5
1,1-dichloroethylene	5	Vinyl chloride	10
1,2-dichloropropane	5		

## **Appendix C**

### **Colorado Water Quality Control Commission Standards**

The Colorado Water Quality Control Commission has promulgated new standards for the Walnut Creek and Woman Creek drainages downstream from the Rocky Flats Plant. The EPA has not yet written a new NPDES permit that reflects these standards; however, in the spirit of the Agreement in Principle completed between the DOE and the State of Colorado, the plant is attempting to meet the standards at this time.

# Appendix D

## Distribution

### Federal Agencies

US DOE, RFO  
Attn: R.M. Nelson, Jr.  
Bldg. 115

US EPA  
Attn: Dr. M. Lammering,  
R. Rutherford  
One Denver Place - Suite 1300  
999 18th Street  
Denver, CO 80202-2413

US EPA  
Attn: B. Lavelle  
999 18th Street, Suite 500  
8 HWM-FF  
Denver, CO 80202-2405

### State Government Agencies

Colorado Water Conservation Board  
Attn: N.C. Ioannides  
823 State Centennial Building  
1313 Sherman Street  
Denver, CO 80203

Denver Regional Council of  
Governments  
Attn: L. Mugler  
2480 W. 27th Avenue, #200B  
Denver, CO 80211

Department of Natural Resources  
Attn: B. Hamlett III  
1313 Sherman Street  
Denver, CO 80203

Rocky Flats Environmental  
Monitoring Council  
Attn: G. Swartz  
1536 Cole Blvd., Suite 325  
Denver West Office Park #4  
Golden, CO 80401

### City Governments

City of Arvada  
Utilities Division  
Attn: M. Mauro  
8101 Ralston Road  
Arvada, CO 80002

City of Boulder  
Office of the City Manager  
Attn: J. Piper, A. Struthers  
P.O. Box 791  
Boulder, CO 80302

City of Broomfield  
Attn: H. Mahan, K. Schnoor  
#6 Garden Office Center  
P.O. Box 1415  
Broomfield, CO 80038-1415

City of Fort Collins  
Office of the City Manager  
Attn: S. Burkett  
300 La Porte  
Fort Collins, CO 80525

City of Northglenn  
Attn: N. Renfroe  
11701 Community Center Drive  
Northglenn, CO 80233-1099

City of Thornton  
Attn: J. Ethredge, City Manager  
9500 Civic Center Drive  
Thornton, CO 80229-1120

City of Westminster  
Attn: W. Christopher, S. Ramer,  
D. Cross  
4800 W. 92nd Avenue  
Westminster, CO 80030

Denver Water Department  
Quality Control  
Attn: J. Dice  
1600 W. 12th Avenue  
Denver, CO 80254

### Health Departments

Boulder City/County Health  
Department - Division of  
Environmental Health  
Attn: T. Douville, V. Harris  
3450 Broadway  
Boulder, CO 80020

Colorado Department of Health  
4300 Cherry Creek Drive South  
Denver, CO 80222-1530  
Attn: J. Bruch, R. Fox, D. Holme,  
J. Jacobi, E. Kray, A. Lockhart, P.  
Nolan, R. Quillin, J. Sowinski, R.  
Terry, S. Tarlton

Colorado Department of Health  
Office of Environmental Multimedia  
Focal Group  
4300 Cherry Creek Drive South  
Denver, CO 80222-1530  
Attn: J. Berardini

Jefferson County Health Department  
Attn: Dr. M. Johnson, C. Sanders  
260 South Kipling  
Lakewood, CO 80226

Tri County District Health  
Attn: S. Salyards  
4301 E. 72nd Avenue  
Commerce City, CO 80022

### Environmental

Advance Sciences, Inc.  
Attn: D. Kaskie, M.G. Waltermire  
405 Urban Street, Suite 401  
Lakewood, CO 80228

American Friends Service Co.  
Attn: T. Rauch  
1535 High Street, 3rd Floor  
Denver, CO 80218

F.H. Blaha  
2303 Table Heights Drive  
Golden, CO 80401

Environmental Information Network  
Attn: P. Elofson-Gardine  
8470 W. 52nd Place, Suite 9  
Arvada, CO 80002-3447

IT Corporation  
Attn: C. Rayburn  
5600 S. Quebec, Suite 280D  
Englewood, CO 80111

L.C. Holdings  
Attn: M. Jones  
18300 Hwy 72  
Golden, CO 80403-8222

Margie Reynolds  
8882 Comanche Drivet  
Longmont, CO 80503-8657

National Renewable Energy  
Laboratory  
Attn: R. Noun  
1617 Cole Blvd.  
Golden, CO 80402

PRC Environmental Management,  
Inc.  
Attn: R.J. Fox  
1099 18th Street, Suite 1960  
Denver, CO 80202

Peak Rock Spring Water  
Attn: S. Dolson  
4615 Broadway Street  
Boulder, CO 80304-0509

Rocky Flats Cleanup Commission  
Attn: K. Korkia  
1738 Wynkoop, Suite 302  
Denver, CO 80202

Sierra Club - Rocky Mountain  
Chapter  
Attn: Dr. E. DeMayo  
11684 Ranch Elsie Road  
Golden, CO 80203

W. Gale Biggs Associates  
Attn: Dr. W. Gale Biggs  
P.O. Box 3344  
Boulder, CO 80307

Woodward Clyde/ERCE  
Attn: W. Glasgow  
Stanford Place 3, Suite 415  
4582 S. Ulster Street Pkwy.  
Denver, CO 80237

Wright Water Engineers  
Attn: J. Jones, S. Kribs  
2490 W. 26th Avenue, Suite 100A  
Denver, CO 80211

### Other

National Center for Atmospheric  
Research  
Attn: S. Sadler  
P.O. Box 3000  
Boulder, CO 80307-3000

Physicians for Social  
Responsibility  
Attn: T. Perry  
1000 16th NW, Suite 810  
Washington, D.C. 20036

R.M. Borinsky  
13004 Lowell Court  
Broomfield, CO 80020

W.J. Jones  
10986 W. 77th Avenue  
Arvada, CO 80005

T.T. Matsuo  
11746 W. 74th Way  
Arvada, CO 80005

R.D. Morgenstern  
3213 W. 133rd Avenue  
Broomfield, CO 80020

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11767 W. 74th Way  
Arvada, CO 80005

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5993 W. 75th Avenue  
Arvada, CO 80003

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13631 W. 54th Avenue  
Arvada, CO 80002

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11122 Seton Place  
Westminster, CO 80030

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Arvada, CO 80005

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